an electrical circuit providing a first voltage across said first capacitor, and a second voltage across said second capacitor to provide position-dependent electrostatic forces on said first proof-mass and on said second proof-mass, said position-dependent forces having a component along an axis substantially orthogonal to said first displacement axis, the magnitude of said position-dependent force varying in proportion to proof-mass displacement along said first displacement axis.

Remarks

The above Amendments and these Remarks are in reply to the Office Action mailed August 2, 2002. Claims 1 – 10 and 12 -20 are presented herewith for consideration.

Objection to Claim 8

Claim 8 has been objected to because of containing informality. The informality has been corrected, and it is therefore respectfully requested that the objection to this claim be withdrawn.

Rejection of Claims 1 and 4 Under 35 U.S.C. §102(b)

Claims 1 and 4 are rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,569,852 to Marek et al. ("*Marek,*et al. ").

It is respectfully submitted claims 1 and 4 are not anticipated in view of *Marek,*et al.. In particular claim 1 calls for:

> an electrical circuit providing a position-dependent electrostatic force having a magnitude varying in proportion to displacement along said first displacement axis.

Likewise claim 4 calls for:

> an electrical circuit providing a voltage across said capacitor to provide a position-dependent electrostatic force on said proof-mass, said

> position-dependent force having a component along an axis substantially orthogonal to said first displacement axis, the magnitude of said position-dependent force varying in proportion to displacement along said first displacement axis.

It is respectfully submitted that neither of these elements is shown in *Marek,* et al. The Examiner's equivalent to the claimed "electrical circuit" is alleged to be disclosed in Col. 4 lines 29-33 of *Marek,* et al.. This passage states:

> The monocrystalline layer 16 can also be provided with an evaluation circuit for the accelerometer sensor in a manner not shown and with the help of a standard process, so that the sensor and the evaluation circuit are arranged on one component part."

At most, in this passage, *Marek,* et al. eludes to an evaluation circuit. As *Marek,* et al. is understood, no further reference is made to the details of the evaluation circuit. There is no disclosure nor understanding of the reference which would lead one to conclude that an evaluation circuit is not the equivalent of "...an electrical circuit providing a position-dependent electrostatic force having a magnitude varying in proportion to displacement along said first displacement axis", as defined claim in claim 1 and "...an electrical circuit providing a voltage across said capacitor to provide a position-dependent electrostatic force on said proof-mass..." defined in claim 4.

In support further of this rejection, the Examiner states that the "... electrical circuit providing a position-dependent force (i.e. acceleration force) along the first displacement axis" (Page 3 lines 3-5 of the Office Action). However, it is respectfully submitted that the acceleration force in *Marek,*et al. would not be position-dependent whether along the X- or Y-axes: an acceleration force is related by Newton's Law F = ma which is *independent of position.*

Hence, each and every element of the claimed invention, an in particular the "electrical circuitry" defined in claims 1 and 4, is not present in *Marek,* et al. It is therefore respectfully submitted that claims 1 and 4 are not anticipated by *Marek,* et al.

Rejection of Claims 1, 4 and 13 Under 35 U.S.C. §102(b)

Claims 1, 4 and 13 are rejected under 35 U.S.C. §102(b) as being anticipated by either Publication entitled "Micromechanical LIGA-gyroscope by Schumacher et al. ("*Schumacher*".) or Publication entitled "New Designs of Micromachined Vibrating Rate Gyroscopes with Decoupled Oscillation Modes" by Geiger et al. ("*Geiger*").

Claim 1 and 4, as noted above, include limitations directed to an "electrical circuit" providing a "...position dependent electrostatic force". Likewise, claim 13 calls for:

> an electrical circuit providing a first voltage across said first capacitor, and a second voltage across said second capacitor to *provide position-dependent electrostatic forces* on said first proof-mass and on said second proof-mass, said position-dependent forces having a component along an axis substantially orthogonal to said first displacement axis, the magnitude of said position-dependent force varying in proportion to proof-mass displacement along said first displacement axis.

In *Geiger* and *Schumacher* (and *Marek,* et al. above) the comb finger structures are used as position detectors, not to provide a "position dependent force" as defined in claim 13.

This is clearly labeled in Figure 3 of Geiger. Again, an acceleration force is not position dependent, as the Examiner asserts in the argument on Page 3, Paragraph No. 4 of the Office Action

Geiger is principally a paper about a "rotating gyroscope" as shown in Figure 2. The only reference to the finger structure in Figure 3 is on page 1129 col.2 third paragraph. There

is no mention of an electrical circuit in this paragraph, nor an electrical circuit providing a position-dependent force. In fact, the reference states that "Interdigitated electrodes build the differential detection capacities [sic]", consistent with the figure. ***Id.***

With respect to *Schumacher*, Figure 3 therein is a close up of the component labeled "mass, detector" in Figure 2 therein. On page 1574, Col. 2, third full paragraph:

> The inertial mass and the detector are shown in fig. 3. Fingers of a comb electrode are attached to the frame of the inertial mass. They mesh with corresponding electrodes, which are fixed to the substrate. The finger pairs form a capacitor, whose gap width changes when the frame is deflected in the y-direction.

Again, these fingers are used as detectors - to detect changes in gap width along the y-direction. There is no electrical circuitry shown that provides a "position dependent force". Indeed, the mass is forced by comb-fingers (having equal spacing between fingers) as delineated at col. 1 paragraph 4 : "The mass is driven by an electrostatic comb actuator, which is integrated into a frame around the inertial mass detector (fig.2)", which is also labeled an actuator in figure 2.

Hence, there is no electrical circuit as defined in claims 1, 4 and 13 in either *Schumacher or Geiger.*

<u>Rejection of Claims 2-3, 5-10, 12 and 14-20 Under 35 U.S.C. §103(a)</u>

Claims 2-3, 5-10, 12 and 14-20 are rejected under 35 U.S.C. §103(a) as being unpatentable over either *Marek* or *Schumacher* or *Geiger* in view of U.S. Patent No. 6,230,563 to Clark et al. ("*Clark*").

It is respectfully submitted that one of average skill in the art would not find the invention defined in claims 2 – 3, 5 – 10, 12 and 14 – 20 obvious in view of the cited prior art. In particular, nothing in the prior art would lead one of average skill to provide an electrical circuit providing a "position dependent force".

Claims 2 -3 , 5 – 10, 12, 14 – 19

As noted above, none of the independent claims 1, 4, or 13 from which claims 2 –3 , 5 – 10, 12, 14 – 19 depend include an “electrical circuit” as claimed.

With respect to *Marek,*et al., it is noted that *Marek,*et al. fails to disclose even how its evaluation circuit would be connected. However, as the reference is understood, the clear intention of *Marek,*et al.’s evaluation circuit is to measure the "capacitance changes in the case of a longitudinal [Y-Axis] displacement of the seismic mass 10, thus allowing the acceleration to be detected through the changing capacitance." (*Marek,*et al. Col 3 lines 15-18), not "provide a position dependent force having a magnitude varying in proportion to displacement along said first displacement axis" (as defined by claim 1.)

If understood, the Examiner’s reference to *Marek* et al. requires the “first displacement axis” of Claim 1 to be identified by Examiner as the Y-axis of *Merck* et al.

Marek, et al. states that the "seismic mass 10 can move in its longitudinal direction [Y-Axis] in response to the occurrence of corresponding accelerations relatively to the substrate 12 in the direction of the arrow [Y-Axis]". The suspension elements 11 shown by *Marek,* et al. are stiff in the X-axis, (Examiner's displacement axis) and thus the structure shown would resist motion along the axis identified by the Examiner: parallel to the first displacement axis.

Clark et al. does not add anything in the way of an “electrical circuit” as claimed. The quoted section of the *Clark* et al. reference discusses a quadrature-error cancellation structure comprised of the fingers and proof masses.

It is therefore respectfully submitted that one of average skill in the art would not find the invention defined in claims 2 –3 , 5 – 10, 12, 14 – 19, dependent from claims 1, 4, and 13 and including all the limitations thereof, obvious in view of *Marek,* et al..

With respect to *Schumacher* et al, and *Geiger* as noted above, there is no disclosure of an electrical circuit as defined in independent claims 1, 4 and 13, and hence dependent claims 2 –3, 5 – 10, 12, 14 – 19. Again Clark does not add anything in the way of an "electrical circuit" as claimed.

At most, the prior art references show the fingers being used as position detection elements of some sort

In addition, with respect to all the above references, an a new and unexpected result obtained as identified at page 15, lines 12-15 of the present application. By including an electrical circuit to provide "a position dependent force": "A quadrature-nulling force, with Y-Axis value having a component proportional to X-Axis displacement, is generated by applying a voltage V between the two electrical nodes formed by like interconnected fingers"

It is therefore respectfully submitted that one of average skill in the art would not find the invention defined in claims 2 –3 , 5 – 10, 12, 14 – 19, dependent from claims 1, 4, and 13 and including all the limitations thereof, obvious in view of *Schumacher* et al, or *Geiger*..

Claim 20

Further with respect to claim 20, the invention defined therein requires:

> a quadrature detection circuit having an output, said quadrature detection circuit synchronized with the output of said oscillation-sustaining feedback loop; and
> a feedback connection from the output of said quadrature detection circuit to said capacitor, said feedback connection providing a voltage across said first capacitor;

The Examiner has not demonstrated how the alleged portions of the prior art references *Marek,* et al., *Schumacher* et al or *Geiger* et al. show the claimed "quadrature detection circuit" or "feedback connection". As noted above, at most these devices provide position detection, the details of which are not specified and would not lead one of average skill in the art to make and use the invention at the time the present application was filed.

Based on the above amendments and these remarks, reconsideration of Claims 1-10 and 12 - 20 is respectfully requested.

The Examiner's prompt attention to this matter is greatly appreciated. Should further questions remain, the Examiner is invited to contact the undersigned attorney by telephone.

The Commissioner is authorized to charge any underpayment or credit any overpayment to Deposit Account No. 501826 for any matter in connection with this response, including any fee for extension of time, which may be required.

Respectfully submitted,

Date: January 2, 2003

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APPENDIX

Below are a copy of claims showing the amendments.

1. (Twice Amended) A movable microstructure comprising:

a first finger set comprising two or more first fingers extending substantially parallel to a first displacement axis;

a second finger set comprising at least one second finger, said at least one second finger extending substantially parallel to said first displacement axis, terminating between said two first fingers, wherein said at least one second finger is substantially closer to one of the two first fingers between which said at least one second finger terminates; and

an electrical circuit providing a position-dependent electrostatic force having a magnitude varying in proportion to displacement along said first displacement axis.

2. The movable microstructure of claim 1 wherein said two or more first fingers comprise a conductive material, having a thickness between 2 and 100 microns, a width between 1 and 25 microns, a finger length between 2 to 50 microns, and an overlap length of more than 2 microns.

4. (Twice Amended) A movable microstructure comprising:

a substrate;

a proof-mass disposed above said substrate;

a first finger set comprising two or more first fingers extending substantially parallel to a first displacement axis from said proof-mass;

a second finger set comprising at least one second finger, said at least one second finger is affixed to said substrate and extending substantially parallel to said first displacement axis towards said proof-mass, terminating between said two first fingers, wherein said at least one second finger is closer to one of the two first fingers between which said at least one second finger terminates, thereby forming a capacitor; and

an electrical circuit providing a voltage across said capacitor to provide a position-dependent electrostatic force on said proof-mass, said position-dependent force having a component along an axis substantially orthogonal to said first displacement axis, the magnitude of said position-dependent force varying in proportion to displacement along said first displacement axis.

8. (Once Amended) The movable microstructure of claim 6 further including:

a quadrature detection circuit having an output, said quadrature detection circuit synchronized with the output of said oscillation-sustaining feedback loop; and

a feedback connection from the output of said quadrature detection circuit to said first capacitor, said feedback connection providing a voltage across said first capacitor;

wherein said voltage provided by said feedback connection causes the average output of said quadrature detection [circuitry] circuit to converge towards a constant value, thereby causing said mass to vibrate, absent a Coriolis force, more precisely along said first axis.

13. (Twice Amended) A movable microstructure comprising:

a substrate;

a first proof-mass disposed above said substrate;

a second proof-mass disposed above said substrate;

a first finger set comprising two or more first fingers affixed to said substrate and extending substantially parallel to a first displacement axis towards said first proof-mass;

a second finger set comprising at least one second finger, said at least one second finger extending substantially parallel to said first displacement axis from said first proof-mass, terminating between said two first fingers, wherein said at

least one second finger is closer to one of the two first fingers between which said at least one second finger terminates, thereby forming a first capacitor;

a third finger set comprising two or more third fingers affixed to said substrate and extending in a direction opposite said first finger set and substantially parallel to said first displacement axis towards said second proof-mass;

a fourth finger set comprising at least one fourth finger, said at least one fourth finger extending substantially parallel to said first displacement axis from said second proof-mass, along a direction opposite said second fingers, terminating between said two third fingers, wherein said at least one fourth finger is closer to one of the two third fingers between which said at least one fourth finger terminates, thereby forming a second capacitor; and

an electrical circuit providing a first voltage across said first capacitor, and a second voltage across said second capacitor to provide position-dependent electrostatic forces on said first proof-mass and on said second proof-mass, said position-dependent forces having a component along an axis substantially orthogonal to said first displacement axis, the magnitude of said position-dependent force varying in proportion to proof-mass displacement along said first displacement axis.

14. The movable microstructure of claim 13 further including an oscillation-sustaining feedback loop having an output representative of the relative displacement between said first proof-mass and said second proof-mass along said first displacement axis, said oscillation-sustaining feedback loop using electrostatic forces to sustain oscillatory motion.

15. The movable microstructure of claim 14 further including:

a capacitive bridge responsive to the relative displacement between said first proof-mass and said second proof-mass along an axis orthogonal to said first displacement axis; and

a position sense interface connected to said capacitive bridge, said position sense interface having an electrical output varying in response to changes in said capacitive bridge.

16. The movable microstructure of claim 14 wherein said first voltage and said second voltage are distinct, are substantially constant, and are chosen to cause said each said proof mass, absent a Coriolis force, to vibrate more precisely along said first axis.

17. The movable microstructure of claim 15 further including:

a quadrature detection circuit having an output, said quadrature detection circuit synchronized with the output of said oscillation-sustaining feedback loop; and

a feedback connection from the output of said quadrature detection circuit to said first capacitor and said second capacitor, said feedback connection providing said first voltage and said second voltage;

wherein said first voltage and said second voltage cause the average output of said quadrature detection circuit to converge towards a constant value, thereby causing each said proof mass to vibrate, absent a Coriolis force, more precisely along said first axis.

18. The movable microstructure of claim 14 further including:

a fifth finger set comprising two or more fifth fingers affixed to said substrate and extending substantially parallel to a first displacement axis towards said first proof-mass in the direction of said first fingers;

a sixth finger set comprising at least one sixth finger, said at least one sixth finger extending substantially parallel to said first displacement axis from said first proof-mass along the direction of extension of said second fingers, terminating between said two fifth fingers, wherein said at least one sixth finger is substantially closer to the fifth finger opposite in direction of said first smaller gap in relation to said at least one second finger, thereby forming a third capacitor;

a seventh finger set comprising two or more seventh fingers affixed to said substrate and extending substantially parallel to a first displacement axis and towards said second proof-mass;

an eighth finger set comprising at least one eighth finger, said at least one eighth finger extending substantially parallel to said first displacement axis from said second proof-mass opposite the direction of the second fingers, terminating between said two seventh fingers, wherein [each] said at least one eighth finger is substantially

closer to the seventh finger opposite in direction of said second smaller gap in relation to said at least one fourth finger, thereby forming a fourth capacitor; and

an electrical circuit providing a third voltage across said third capacitor, and a fourth voltage across said fourth capacitor to provide position-dependent forces on said first proof-mass and on said second proof-mass, said position-dependent forces having a component along an axis substantially orthogonal to said first displacement axis, the magnitude of said position-dependent force varying in proportion to proof-mass displacement along said first displacement axis.

19. The movable microstructure of claim 18 further including:

a capacitive bridge responsive to the relative displacement between said first proof-mass and said second proof-mass along an axis orthogonal to said first displacement axis;

a position sense interface connected to said capacitive bridge, said position sense interface having an electrical output varying in response to changes in said capacitive bridge;

a quadrature detection circuit having an output, said quadrature detection circuit synchronized with the output of said oscillation-sustaining feedback loop;

a feedback connection from the output of said quadrature detection circuit to said first capacitor, said second capacitor, said third capacitor and said fourth capacitor, said feedback connection providing said first voltage, said second voltage, said third voltage and said fourth voltage; and

a Coriolis detection circuit having an electrical signal output representative of rotational motion about an axis largely orthogonal to both a sense axis and said first displacement axis, said Coriolis detection circuit synchronized with the output of said oscillation-sustaining feedback loop.